Well Waters of the Regional Agricultural Research Station, Tindivanam - Their Suitability for Irrigation

by

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The quality of irrigation water is determined by four factors: viz., composition and concentration of soluble salts, nature of the soil to be irrigated, nature of the crop to be grown and the climate of the locality. Eaton (1950) classified irrigation waters into three classes: viz. suitable, marginal and unsuitable based on the excess of carbonates and bicarbonates over the lime content. The workers of the United States Salinity Laboratory (1954) proposed certain standards for judging the irrigation suitability of a given water based on its electrical conductivity and sodium adsorption ratio. Quite recently Subramani and Varma (1969) developed a numerical rating for evaluating the quality of irrigation water taking into considration the soil and crop characteristics also. A quality appraisal of the irrigation waters of the farm based on the above recent concepts has not been made so far which at the same time is an important information. Hence, an attempt has been made in this paper to collect the quality data of the well waters of the station at a time when they were fully used for irrigation and interpret them with respect to their irrigation suitability.

Materials and Methods: The 13 functioning wells in the station are all open wells and water is pumped out for irrigating paddy, groundnut, gingelly, castor, cholam, etc. grown in an area of about 25 acres. Water samples were collected from all the wells on the same day in November '69 when waters were being pumped out for irrigation. All the wells were full after the receipt of the monsoon rains in October, 1969. The composition and concentration of soluble salts were determined as per the standard laboratory methods (Sankaram 1965) and expressed as meq/lit. Sodium was estimated by difference (total anions-calcium + Magnesium). The residual sodium corbonate value were calculated from the formula $(Co3+HCo3)-(Ca+Mg)$ and sodium adsorption ratio (SAR) by the formula $Na/\sqrt{ca+mg}/2$. The pH and Ec were determined by Trombay pH meter and Elico Ec meter respectively.

Results and discussion: The results of analysis of the water samples are presented in Table I. All the waters are free from any suspended impurity and are quite clear. The total soluble salts in all cases are less than 1000 ppm. The pH is near neutral in 6 cases and above 8 in others. According to the older standard wherein only these two characters are considered the water is quite suitable for irrigation in any soil and for any kind of crop.

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TABLE 1. *Analysis of well water samples from the Regional Agricultural Research Station, Tindivanam*

Description of sample	Anions meq/litre				Cations meq/litre							
	CO_3	HCO_3	Cl	SO_4	Ca	Mg	Na by difference	T.S. ppm	E.C. 10^3	pH	Residual Na_2CO_3	SAR
F 17 well	Nil	4.00	1.77	3.07	3.40	3.32	2.12	540	0.84	7.2	<1.0	1.20
F 5 well	0.10	3.55	1.97	1.29	3.40	1.83	1.71	530	0.84	8.2	<1.0	1.10
F 6 well	0.10	3.05	1.77	2.47	3.20	0.52	3.67	460	0.72	8.2	<1.0	2 60
F 3a well	Nil	3.90	2.07	2 97	3.70	2.50	2.74	630	0.98	7.3	<1.0	1.50
J 10 well	Nil	4.00	0.99	2.60	2.95	2.97	1.67	440	0.70	7.2	<1.0	1.00
New lab. well	0.20	3.10	1.09	1.04	1.80	1.62	2.10	440	0.69	8.3	<1.0	1.70
Nursery well	Nil	4.20	1.47	3.19	3.00	1.23	4.63	596	0.93	7.3	<1.0	3.20
Uthukuttai well	Nil	4.40	1.18	2.57	2.49	1.73	3.83	455	0.71	7.3	<1.0	2.60
H 13 well	Nil	4.50	2.07	3.33	4.00	2.17	3.73	585	0.91	7.2	<1.0	2 10
H 5 well	0.40	4.40	0.98	3.63	2.40	1.23	5.78	400	0.62	8.6	1.17	3.40
K 5 well	0.20	2.70	0.98	1.08	2.10	1.46	1.40	399	0.62	8.4	<1.0	1.10
H 6 well	0.40	4.61	2.35	5.52	2 70	1.24	8.94	655	1.02	8.7	1.07	6.40
K 7 well	0.40	4.40	0.88	2.38	2.10	1.83	4.07	345	0.53	8.6	<1.0	2.90

< = Less than

Based on his observations on the irrigation waters of the Nile and Euphrates, Eaton (1950) observed that excess of bicarbonates plus carbonates over the lime elements termed as residual sodium carbonate in the irrigation water would lead to the development of higher sodium percentage in the soil solution through the precipitation of the lime elements as carbonates. The following classes and interpretation were suggested for Residual Sodium Carbonate (RSC).

R.S.C.	*Class value.*	*Interpretation.*
Lsss then 1.25 meq/lit.	1	Suitable
Between 1.25 to 2.5 ,,	2	Marginal
More than 2.5 meq/lit.	3	Unsuitable.

Judging the well waters of the farm against this standard, it may be seen that all the waters are quite good for irrigation.

The most common and widely used standard for judging the quality of irrigation water is the one proposed by the workers of the U.S.S.L. (1954). In this method the electrical conductivity of the water is taken as a measure of salinity hazard and Sodium adsorption ratio (SAR), defined as $Na\sqrt{Ca + Mg/2}$ is taken as an index of alkali hazard. A diagram showing 16 classes of water covering a wide-range of conductivity from 0 to 2.25 and above mmhos/cm and SAR from 0 to 26 and above are considered useful for irrigation purposes.

TABLE 2. *Interpretation of result of analytical data of irrigation water samples from the Regional Agricultural Research Station, Tindivanam*

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Heads of analysis	*F17 well* Value	Class	*F5 well* Value	Class	*E6 well* Value	Class	*F3a well* Value	Class
Data for water:								
1. Conductivity mmhs/cm	0.84	C3	0.84	C3	0.72	C2	0.98	C3
2. S.A.R.	1.20	S1	1.10	S1	2.60	S1	1.50	S1
3. R.S.C.	<1.0	1	<1.0	1	<1.0	1	<1.0	1
Data for soil:								
4. Texture	Sandy loam	2.5	Sandy loam	2.5	loam	3	Sandy loam	2.5
5. Permeability	Rapid	1	Rapid	1	Moderate	2	Rapid	1
Total	—	8.5	—	8.5	—	9	—	8.5
Suitability	The water is suitable for semi-tolerant crops such as rice, jowar, castor and groundnut.		–do–	–do–	–do–	–do–	–do–	–do–
Data for water:	*J10 well*		*New lab well*		*Nursery well*		*Uthukuttai well*	
1. Conductivity mmhs/cm	0.70	C2	0.69	C2	0.93	C3	0.71	C2
2. S.A.R.	1.00	S1	1.70	S1	3.20	S1	2.60	S1
3. R.S.C.	<1.0	1	<1.0	1	<1.0	1	<1.0	1
Data for soil:								
4. Texture	Loam	3	Sandy loam	2.5	Sandy loam	2.5	Sandy loam	2.5
5. Permeability	Moderate	2	Rapid	1	Rapid	1	Rapid	1
Total	—	9	—	7.5	—	8.5	—	8.5
Suitability	The water is suitable for semi-tolerant crops such as rice, jowar, castor and groundnut.		The water is suitable for sensitive crops such as field beans, radish, guava. Semi-tolerant crops such as rice, jowar, groundnut may also be grown.		The water is suitable for semi-tolerant crops such as rice, jowar, castor and groundnut.		–do–	

Heads of analysis	*H13 well*		*H5 well*		*K5 well*		*H6 well*	
	Value	Class	Value	Class	Value	Class	Value	Class
Data for water:								
1. Conductivity mmhs/cm	0.91	C3	0.62	C2	0.62	C2	1.02	C3
2. S.A.R.	2.10	S1	3.40	S1	1.10	S1	6.40	S1
3. R.S.C.	1.10	1	1.17	1	<1.00	1	1.07	1
Data for soil:								
4. Texture	Sandy loam	2.5	Sandy loam	2.5	loam	1	Sandy loam	2.5
5. Permeability	Rapid	1	Rapid	1	Moderate	2	Rapid	1
Total	—	8.5	—	7.5	—	9	—	8.5
Suitability	The water is suitable for semi-tolerant crops sueh as rice, jowar, castor and groundnut.		The water is suitable for sensitive c ops such as field beans, radish, guava. Semi-tole ant crops such as rice, jowar, groundnut may also be grown.		The water is suitable for semi-tolerant crops such as rice, jowar, castor and groundnut.		The water is suitable for semi-tolerant crops such as rice, jowar, castor and groundnut.	

Heads of analysis	*K7 well*	
	Value	Class
Data for water:		
1. Conductivity mmhs/cm	0.53	C2
2. S.A.R.	2.90	S1
3. R.S.C.	<1.0	1
Data for soil:		
4. Texture	Sandy loam	2.5
5. Permeability	Rapid	1
Total	—	7.5
Suitability	The water is suitable for sensitive crops such as field beans, guava, radish semi-to'erant crops such as rice, jowar, groundnut may also be grown.	

Subramani and Varma (1969) modified the above diagram and gave the class limits and interpretation for salinity and SAR.

Salinity hazard : Conductivity mmhos/cm.	*Class value.*	*Interpretation.*
Less than 0.25	C1 (low)	Excellent
Between 0.25 to 0.75	C2 (medium)	Good.
Between 0.75 to 2.25	C3 (high)	Doubtful.
Greater than 2.25	C4 (very high)	Unsuitable.

Alkali hazard : The alkali hazard is divided into four classes. These classes are obtained by evaluating the SAR value along with the conductivity from a diagram, "classification of irrigation water" proposed by the U. S. S. L (1954) but modified by Subramani and Varma (1969) for soil conditions. The four classes with their interpretation are as follows :

Class value.	*Interpretation.*
S1	Can be used on almost all soils.
S2	Appreciable sodium hazard with fine textured soils. Can be used on coarse textured soils.
S3	May produce harmful levels of Na in most soils and will require special soil management.
S4	Generally unsatisfactory for irrigation.

In evaluating the quality of irrigation water, the results of analysis in the laboratory have to be considered along with two important soil characteristics, which have a bearing on irrigation, namely soil texture and permeability and the salt tolerance of crops proposed to be irrigated. Subramani and Varma (1969) suggested the following classification for the soil and crop characters.

Soil texture	*Class value*
Texture :	
Sandy, loamy sand	1
Sandy loam	2.5
Loam	3
Clay loam	3.5
Clay	4
Soil permeability :	
Rapid	1
Moderate	2
Slow	3
Salt tolerance of crops :	
Salt tolerant	1
Semi tolerant	2
Sensitive	3

The water is suitable for sensitive crops such as field beans, guava, radish semi-tolerant crops such as rice, jowar, groundnut may also be grown.

Suitability

The authors further suggested that if the sum of the class values in respect of conductivity, alkali hazard, residual sodium carbonates of a given water sample and class values in respect of texture and permeablility of the soil to be irrigated is 11 or greater, the water is unsuitable for irrigation. If less than 11, it can be used for irrigation, but the crop to be irrigated must be chosen in such a way that the salt tolerant class value of the crop when added to the total class value in respect of the water and the soil does not exceed 11.

The analytical data in respect of well waters evaluated according to the method suggested above and the results are given in Table 2. It will be seen from the table that the all the waters are quite suitable for the semi-tolerant crops (rice, groundnut, millets etc,) grown in the farm in sandy to sandy loam soils. Three well waters namely, the new laboratory well, H5 well and K 7 well have been rated as better than the others and can be used even for sensitive crops.

Summary and Conclusion : A quality appraisal of the well waters of the Regional Agricultural Research Station, Tindivanam was made in November '69, during which period of the year all the wells were fully used for irrigation to paddy and other crops. The analytical data were judged against the standards set by various workers for rating the quality of water for irrigation suitability. All the waters were found to be quite suitable for the semi-tolerant crops like paddy, castor, groundnut, etc. grown in the light textured soils of the farm possessing moderate to rapid soil permeability.

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